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BIOLOGICAL SURVEY—BULLETIN No. 29

C. HART MERRIAM, *Chief*

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THE RELATION OF BIRDS TO THE COTTON BOLL WEEVIL

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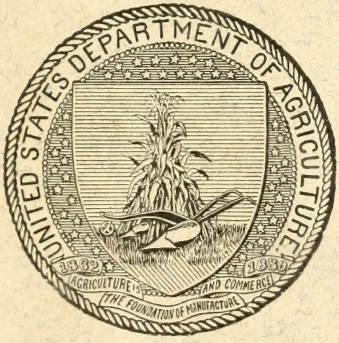
BY

ARTHUR H. HOWELL

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY



WASHINGTON

GOVERNMENT PRINTING OFFICE

1907

TWO IMPORTANT ENEMIES OF THE BOLL WEEVIL

[Top figure, male Baltimore Oriole; middle figure, male Orchard Oriole; bottom figure, female Orchard Oriole.]

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THE RELATION OF BIRDS TO THE COTTON BOLL WEEVIL

BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Biological Survey,
Washington, D. C., July 17, 1907.

Sir: I have the honor to transmit herewith for publication as Bulletin No. 29 of the Biological Survey a report of progress on the work in relation to the cotton boll weevil, by Arthur H. Howell.

As a result of investigations during the years 1906 and 1907, our knowledge of the part birds play in restricting the ravages of the pest was considerably increased, and a number of additional species were found to feed upon the weevil. Practical suggestions are made in the bulletin for increasing the numbers of swallows breeding in the cotton districts, swallows having been ascertained to be among the most important enemies of the pest.

Respectfully,

H. W. Henshaw,
Acting Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

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THE RELATION OF BIRDS TO THE COTTON BOLL WEEVIL.

INTRODUCTION.

In view of the rapid spread of the cotton boll weevil in the Southern States and the enormous damage to the cotton crop through its ravages, a study of the relations of our native birds to the pest is of increasing importance. Investigation of the problem during several seasons has shown that while birds can not be depended upon to stay its progress, much less to exterminate it, yet the service they render in controlling it is of great importance. It has been discovered that several species of birds eat great numbers of the pest and among the weevil-eating kinds are a few whose numbers it is believed can be greatly augmented through careful protection and by providing them with safe nesting places.

PROGRESS OF THE INVESTIGATION.

The relation of birds to the boll weevil has been studied by the Biological Survey during portions of four seasons, and by the Bureau of Entomology during portions of two seasons. Seventeen species of birds were examined during the seasons of 1903 and 1904 by the Bureau of Entomology, with the result that 11 species were found to feed on the weevil.[a] In November and December, 1904, Vernon Bailey, of the Biological Survey, took up the study of the problem, and, as a result of the examination of 354 stomachs collected by him, 9 additional species of birds were added to the list of boll weevil destroyers.[b] The work was carried on in the summer and fall of 1905 by the present writer, 62 species of birds being collected and examined and 8 additional species found to feed on the weevil.[c] The investigation was continued, also by the writer, in August and September, 1906, and from February 11 to May 3, 1907. Fifteen species were added to the list of weevil-eating birds by the investigations in the past two seasons, details of which will be given later.

[a] Bul. 51, Bureau of Entomology, U. S. Dept. of Agriculture, 1905, pp. 150–153.
[b] Bul. 22, Bureau of Biological Survey, U. S. Dept. of Agriculture, 1905.
[c] Bul. 25, Bureau of Biological Survey, U. S. Dept. of Agriculture, 1906.

SUMMARY OF RESULTS.

As a result of investigations carried on intermittently during five seasons, 43 species of our native birds have been found to feed on the weevil, as follows:

Upland plover.
Killdeer.
Quail.
Nighthawk.
Scissor-tailed flycatcher.
Kingbird.
Crested flycatcher.
Phœbe.
Olive-sided flycatcher.
Alder flycatcher.
Least flycatcher.
Cowbird.
Red-winged blackbird.
Meadow lark.
Western meadow lark.
Orchard oriole.
Baltimore oriole.
Bullock oriole.
Brewer blackbird.
Bronzed grackle.
Great-tailed grackle.
Savanna sparrow.
Lark sparrow.
White-throated sparrow.
Field sparrow.
Towhee.
Cardinal.
Pyrrhuloxia.
Painted bunting.
Dickcissel.
Purple martin.
Cliff swallow.
Bank swallow.
Barn swallow.
White-rumped shrike.
Yellow warbler.
Yellow-breasted chat.
American pipit.
Mockingbird.
Brown thrasher.
Carolina wren.
Tufted titmouse.
Black-crested titmouse.

Twenty-three of the foregoing species feed on the weevil principally in summer and 20 species principally in winter. The greatest destruction of weevils in summer is wrought by swallows and orioles; in winter, by blackbirds and meadow larks. It is not to be supposed that the foregoing list includes all the birds which feed upon the boll weevil. Further investigation will doubtless add a number of species to the list and will show that birds which ordinarily eat but few weevils will, under certain conditions, destroy a good many. The funds at the command of the Biological Survey for this investigation have been very limited, but it is hoped that means will be forthcoming not only for continuing the work, but for widening its scope so as to include the regions recently invaded by the boll weevil.

RECOMMENDATIONS.

LEGISLATION NEEDED.

In order to increase the number of useful birds in a given region little need be done in most cases except to protect them from their enemies, chief of which is man.

While most insectivorous birds are adequately protected under the

provisions of the present Texas game law, a few do not receive protection that deserve it. No argument is needed in support of the view that every bird that does effective service in destroying boll weevils should be protected by State laws, at least for the present. In the unlikely event that any protected species shall so increase in numbers as to threaten agricultural interests, either in the cotton-producing area or elsewhere, protection can readily be withdrawn. Protective laws, necessary and beneficial as they are, however, are not so effective in the cause of bird protection as enlightened public sentiment. It is hoped, therefore, that a knowledge of the part birds play in the boll weevil war may be widely disseminated over the cotton-producing area, and that school children may be instructed not only as to the general value of birds, but of the special importance to the South of the kinds which feed upon weevils. They should learn to know them by sight and be taught as part of the duties of good citizens to refrain from robbing their nests, from trapping them to sell abroad as cage birds, and from shooting them for food or sport.

Of the birds at present known to eat the boll weevil, the following species are afforded no protection in Texas: Upland plover, killdeer, cowbird, red-winged blackbird, Brewer blackbird, bronzed grackle or crow blackbird, and great-tailed grackle or jackdaw.

Upland plover.—Of the birds mentioned above the upland plover is in most urgent need of protection, for in recent years, through constant hunting both in spring and in fall, it has diminished markedly in numbers, and unless prompt measures are taken to save it this valuable bird is in danger of final extinction. The Louisiana game law provides a close season for the upland plover ("papabotte") from May 15 to August 1, but as at that season this plover is not found within the State, the bird is practically unprotected there. Upland plovers are almost wholly insectivorous, and in addition to eating the boll weevil in spring, when its destruction is of the highest importance, they render valuable service in destroying numbers of other injurious weevils and other insects. This plover is highly esteemed for the table and as a game bird, but its value for these purposes is infinitesimal compared to the value it possesses to the agricultural interests of the country. Because of its importance as an insectivorous bird the upland plover should be protected at all seasons, and it is considered important that an effort be made by the cotton growers of Texas and Louisiana to have this bird placed in the list of protected species in their respective States.

Killdeer plover.—The killdeer apparently is not decreasing in numbers, since it is of no value for food, and therefore is seldom shot by hunters. But in view of its taste for boll weevils and other destructive

insects, the wiser course would seem to be to give it legal protection and thus afford it every opportunity to increase.

Blackbirds.—The several species of blackbirds, though not shot to any extent for food, are often killed wantonly for sport or in the belief that they are injurious to growing crops. Corn is the only crop in Texas which is liable to injury from blackbirds, and the only species likely to damage this crop to any extent is the big jackdaw, or great-tailed grackle. Investigation of the food habits of this bird by Prof. F. E. L. Beal has shown that nearly half of its food consists of corn, much of which is waste grain, and about one-fourth of insects.

The Brewer blackbird and the bronzed grackle both eat corn to some extent, but they are not generally accused of damaging this crop in Texas, and both species have a pronounced fondness for feeding on grubs and other insects in freshly plowed fields. It is believed that their destruction of boll weevils much more than compensates for any damage they may do to corn or other grain. Indeed, the writer is inclined to consider the Brewer blackbird one of the most useful birds in the State to the cotton grower.

Both the cowbird and the redwing render valuable service in the destruction of weed seed, which, in winter at least, furnishes the greater part of their food. The Louisiana law protects all blackbirds, except crow blackbirds (grackles) when actually destroying crops. A similar provision in the laws of Texas prohibiting the killing of any blackbirds, except when they are actually engaged in injuring crops, would seem to be for the best interests of the farmers of that State.

It is not absolutely necessary that the farmers wait for the enactment of protective laws, but in the absence of such laws they should take advantage of the laws against trespass and prohibit all shooting of plover and blackbirds in their cultivated fields.

BIRDS REQUIRING SPECIAL PROTECTION.

Swallows.—Information has been received by the Biological Survey that in west Texas cliff swallows (and probably also barn swallows), which breed about buildings, are frequently killed and their nests destroyed through the mistaken notion that they harbor bedbugs. As a matter of fact, the parasites which infest birds, though resembling to some extent the insects so objectionable to man, are not the same and would quickly perish away from their normal hosts. Hence, wherever these very useful swallows occur, not only should they be allowed to nest, but every effort should be made to protect them and increase their numbers.

Meadow lark.—The fact that the meadow lark is at all times protected by the laws of Texas seems not to be appreciated by many residents of the State, and in consequence many larks are shot for food or sport. In view of the large number of boll weevils destroyed by these birds, they should be rigidly protected, and farmers would do well to see that the law is enforced on their property in the case of these valuable birds.

Painted bunting.—These brilliant little sparrows are in great demand as cage birds, and, although protected in all the Southern States, large numbers are nevertheless trapped and sold to dealers. In addition to their services as weed destroyers, these buntings are now known to capture a considerable number of boll weevils. Every effort therefore should be made to stop the illegal traffic in these beautiful and useful birds.

NESTING BOXES.

Since the purple martin has been found to capture boll weevils both in the spring and in the fall, it is strongly recommended that special efforts be made by cotton growers to increase the numbers of martins feeding over their cotton fields. Though nowhere very abundant, martins are quite generally distributed in the South, so that usually all that is necessary in order to attract additional numbers to a farm is to provide nesting boxes for them. Martins are eminently social in their habits and do not ordinarily feed at a great distance from the home box, so that once a colony becomes established it may confidently be expected to increase from year to year so long as increasing accommodations are provided for the pairs that return each spring after their winter sojourn in South America.[a]

Nesting boxes may be of the simplest and homeliest construction or they may be of elaborate and artistic forms, to suit the taste of those who desire to make the martin house an ornament to the lawn or dooryard. Large gourds are often utilized as nesting boxes, the only preparation necessary being to hollow them out, cut an entrance hole, and tie them to a tall pole. The only objection to their use is that but one pair of martins can be accommodated in each gourd. The more elaborate houses usually take the shape of a residence or other building, and in such cases the entrances to the rooms

[a] The experience of Mr. J. Warren Jacobs, of Waynesburg, Pa., is valuable as showing how rapidly a colony will increase when provided with adequate nesting homes. In 1896 he put up a single house of 20 rooms, which was occupied by 5 pairs of martins, which raised 11 young. The next year 10 pairs returned to the house and raised 35 young. During the third and fourth seasons 2 additional houses were erected, which furnished accommodations for 53 pairs, which raised over 150 young. Thus at the end of the fourth season the colony numbered nearly 300 birds.

represent the open lower half of windows. A martin box may contain almost any desired number of rooms, though boxes with 10 to 20 rooms, placed at intervals about the fields or close to the farm laborers' houses, would seem to best meet the requirements of the situation. The rooms should be about 5 inches wide, 7 inches high, and 8 inches deep, with entrance holes $2\frac{1}{2}$ or 3 inches in diameter. There should be only one entrance to each room. A shelf bordered by a railing should be placed beneath each doorway, in order to prevent the young from falling to the ground when they venture out of the compartment. Small holes in the shelf will prevent water from running into the doorways. A hole in each gable near the roof should be provided for ventilation.

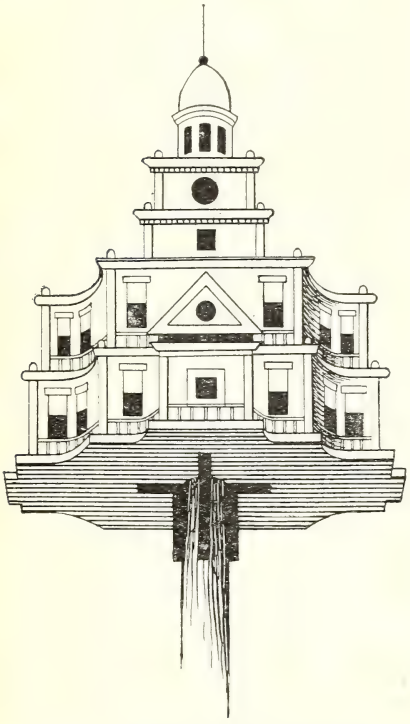

FIG. 1.—An ornamental martin house.

Mr. J. Warren Jacobs advises that all exposed portions of the houses be constructed of poplar, with the bottom of $\frac{3}{8}$-inch oak. His method of attaching the house to the pole is by means of four angle-irons screwed to the bottom of the box and to the sides of the pole. The pole should be at least 15 feet high, as the birds, through fear of cats, will not nest near the ground. If desired, the pole may be provided with a hinge near the ground or be fitted into a socket in the ground, so that the house can readily be taken down.

Mr. E. H. Forbush recommends the use of flour barrels for martin houses as being at once cheap and easily obtained. These, if kept painted and properly roofed, he says, will last for years. In fitting up the interior of the barrel a square box should be inserted in the center to furnish a back for the individual rooms. Large cigar boxes or tin cans may be utilized for the rooms, screwing them to the central box and connecting with the entrance holes by strips of tin or wood. The pole may pass through the center of the barrel and the roof may be constructed of zinc, sheet iron, or painted canvas.

The accompanying illustrations show several styles of martin boxes, and other forms will readily suggest themselves.

Where English sparrows are numerous they must be prevented

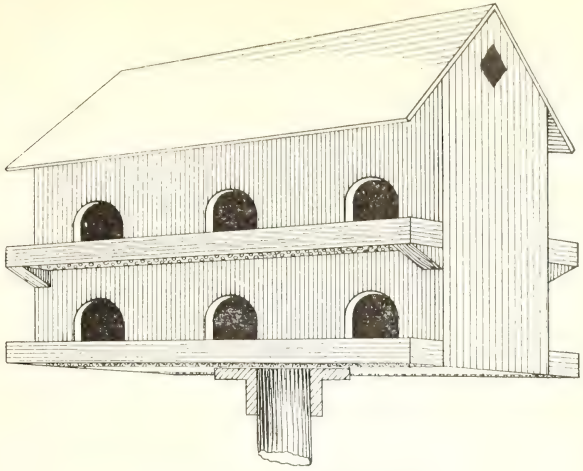

FIG. 2.—A simple martin house.

from monopolizing the martin boxes. This may be accomplished by shooting or poisoning the sparrows, by closing the entrances to the nesting boxes during the winter, or by taking the boxes down until the arrival of the martins in spring.

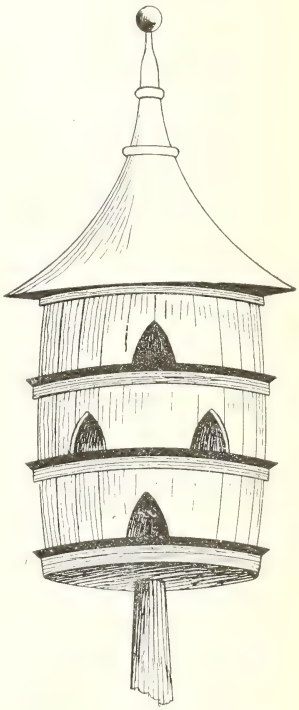

FIG. 3.—A barrel martin house.

CULTURAL METHODS.

Investigation of the habits of birds during the winter months has shown that certain species, notably Brewer blackbirds, bronzed grackles, great-tailed grackles, killdeer, and upland plover, are quickly attracted to fields where plowing or harrowing is going on, and usually when these birds have been shot while following the plow, boll weevils have been found in their stomachs. This is particularly true in fields where the ground is being newly broken or the old cotton stalks first broken down. In view of the pronounced habit on the part of many birds of feeding in cultivated fields, the following suggestions are believed to be worthy of adoption:

1. Break the ground as early in the winter as practicable, at a time when blackbirds are numerous. If after the first plowing the ground is still rough, or if there is any rubbish

about the field, continue to stir or harrow the ground and thus give the birds a chance to pick up the weevils as they are driven from their hiding places.

2. Destroy every stalk of volunteer or seppa cotton before planting time. Investigations during the very mild spring of 1907 showed clearly the folly of allowing seppa cotton to grow. The weevils emerged early from hibernation and at once began to feed on the sprouted plants, which were very numerous all over south Texas and as far north as northern Louisiana. The birds were unable to find the weevils readily after the latter had taken to the plants, and hence large numbers survived until the new cotton was large enough for them to feed upon. Had there been no seppa cotton in the fields the weevils would have been exposed to the attacks of all ground-feeding birds and their numbers would have been materially reduced.

STATUS OF THE SPECIES OF BIRDS KNOWN TO EAT THE BOLL WEEVIL.

SWALLOWS AND MARTINS.

Six kinds of swallows occur commonly in Texas, and four are known to eat the boll weevil. Since the habits of all the species are essentially alike, eventually doubtless all will be found to feed on the insect. Swallows are migratory, nesting in the United States and wintering chiefly in Central and South America. Vast numbers pass through Texas in September on their way to their winter homes, and at this season they find many boll weevils in the air, where they are easily captured. So abundant are the swallows and so marked is their taste for boll weevils that they must be accorded very high rank in the list of the enemies of this destructive insect.

Cliff swallow.—Cliff swallows, eaves swallows, or mud swallows, as they are variously called, nest commonly in the northern and western States and in the western portion of Texas as far east as Austin and Waco. They breed in colonies, and their pouch-shaped nests of mud are plastered to the face of cliffs or stone walls or under the eaves of barns. They are abundant over the greater part of Texas during the autumn migration, and in September thousands pass over the cotton fields every day.

Thirty-five specimens were collected in the fall of 1906 and all but one of them had eaten boll weevils, the majority having taken nothing else. Many of the stomachs were crammed full of the weevils. The largest number eaten by a single bird was 47, while many others had taken from 20 to 30 at a meal. The total number destroyed by these thirty-five birds was 638, an average of 18 weevils to each bird. It is of course impossible to estimate with any degree

of accuracy the number of cliff swallows in the State of Texas during the month of September, but a very conservative estimate of the number passing over the town of Victoria each day of the migration is 10,000. Allowing but one meal a day and assuming that each bird consumed on an average 18 weevils per day for the period of six days during which the flight was under observation, we find that these swallows destroy in one week in a single county more than a million weevils! And this vast number is destroyed without a dollar's expense to the cotton grower. In view of this good service the

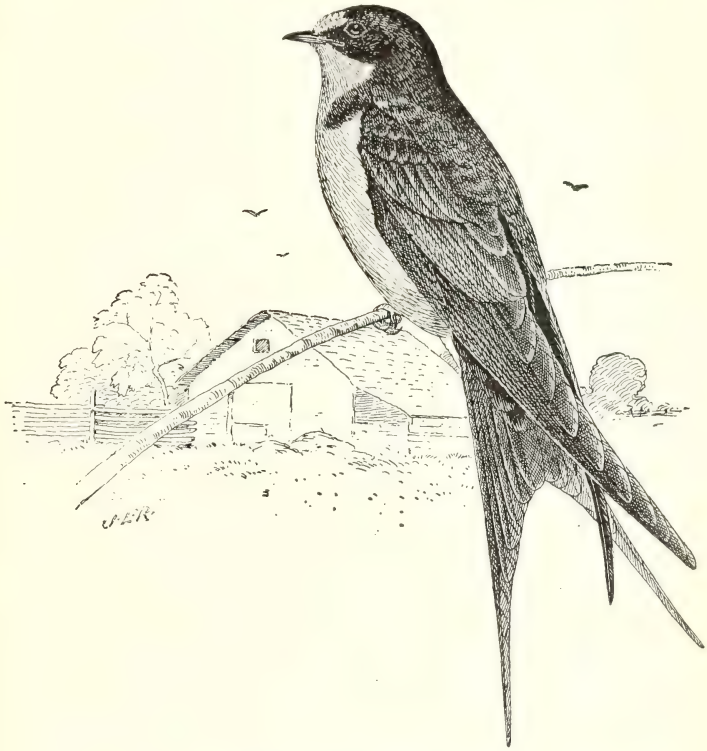

FIG. 4.—Barn swallow.

folly of destroying the nests of swallows and of shooting the birds because they harbor insects is apparent, especially when it is remembered, as stated above, that the swallow parasites are not to be feared by man.

Barn swallow.—Barn swallows are common summer residents in the western portion of Texas, but for some unknown reason do not breed in the eastern part of the State. Even there they are common, however, in the fall, when they join the other swallows in coursing over the cotton fields. They fly very swiftly, often just above the tops of the plants, and many a boll weevil falls a prey to their per-

sistent hunting. Fourteen specimens were examined in September, of which 5 contained boll weevils. The total number of weevils consumed by the 5 birds was 52 and the largest number found in one stomach 23.

Bank swallow.—These swallows, the smallest of the family, are rare in summer in Texas, but occur in large numbers during the fall migration. Twenty-five specimens were collected in September and 11 of them were found to have eaten a total of 68 boll weevils. The largest number in one stomach was 14 and the average number 6.

Purple martin.—Martins occur more or less commonly over the greater part of Texas and the other Southern States. Their abundance in a particular locality depends almost wholly on the number of nest boxes provided for their use, and no birds respond more quickly to an effort to increase their numbers. It has been found impracticable to examine many specimens of this bird, but enough have been secured to show that their food both in the spring and in the fall includes the boll weevil. The only martin collected in September contained one boll weevil, and another bird taken in May also had remains of a boll weevil in its stomach.

Like the other members of this family, martins obtain their food almost wholly in the air. They are not likely, therefore, to capture a large number of weevils except in the fall, when the insects fly freely. The destruction of even a few weevils in the spring, however, is a definite benefit to the cotton crop of that season, and the fact that the martins reach their homes about the cotton fields in February and remain until October, ever ready to snap up the weevils as they fly from plant to plant, renders their services of the highest importance.

FLYCATCHERS.

Seven species of flycatchers have been found to destroy boll weevils, and doubtless all the members of this family feed upon them during the seasons when they are in the air. Most of the flycatchers are summer residents only, but one—the phœbe—stays through the winter. At least two species—the kingbird and the crested flycatcher—begin the war on the weevil in April. It is carried on by the other species throughout the summer and by the phœbe until late autumn or even in winter.

Least flycatcher.—These little birds, the smallest of the family, seem to have a decided fondness for boll weevils, for, of the 14 specimens examined, just one-half had eaten the insect, the total number of weevils destroyed by the 7 birds being 21. The least flycatchers are northern-breeding birds, but migrate southward quite early and do their best work in August and September. These flycatchers on several occasions have been observed to fly down among the cotton

plants, and it is not unlikely that they snatch the weevils directly from the plants as well as when flying.

Kingbird.—Kingbirds, sometimes called bee martins, are common in Texas and Louisiana in summer. They frequent fields and pastures and, like other flycatchers, snap up their prey on the wing. Of the 22 specimens examined in September, 6 had eaten a total of 8 weevils, and, of the 10 specimens examined in April, 1 had taken 1 weevil.

Crested flycatcher.—These flycatchers are among the larger members of the family occurring in the cotton States. They frequent timbered tracts and capture their prey usually at some distance from the ground. One specimen taken in September had eaten 3 boll weevils and 1 taken in April had eaten 2.

Scissor-tailed flycatcher.—The scissor-tails are the largest and also the most abundant flycatchers in Texas, but, unfortunately, their taste leads them to prefer somewhat larger insects than the boll weevil. They do, however, destroy a few weevils, mainly in the autumn. Ninety-one stomachs taken in July, August, and September have been examined, and 5 of them contained a total of 7 weevils.

FIG. 5.—Kingbird.

Phœbe.—These flycatchers are winter residents over the greater part of Texas, and a few breed in the western part of the State. One specimen taken late in September had eaten a boll weevil and 3 taken in November and December had each eaten 1 weevil.

Alder flycatcher.—This species, which resembles the least flycatcher in appearance, is a rare migrant in Texas. Three specimens were taken in September, 1 of which had eaten 2 boll weevils.

Olive-sided flycatcher.—This species breeds in the more northern States and Canada and is found only as a migrant in the South. Two specimens were taken in September, 1 of which had eaten 2 boll weevils.

ORIOLES.

Next to swallows, orioles are probably the greatest destroyers of the boll weevil in summer, and perhaps their services are more important than those rendered by swallows, for the reason that the

orioles spend most of the spring and summer in and about the cotton fields and persistently hunt the weevils when they are feeding on the squares. The orioles pass the winter in Central America, returning to the United States in April, where they remain until October.

Orchard oriole (see frontispiece).—This oriole, the smallest of the group, is generally distributed in Texas and other Southern States. Its purse-shaped nest is built in almost any small tree in the orchard, dooryard, pasture, or field. Orchard orioles make frequent excursions to the cotton fields, especially when the young are fully fledged, and often feed for hours at a time among the cotton plants. They seem to know where to find the weevils when they are feeding upon the squares, and large numbers are destroyed by them in the course of the season.

The orioles evidently begin the work of destruction as soon as they arrive from the South, for one taken April 27 contained a boll weevil in its stomach. During the summer months, of course, they find weevils with greater ease, and at this season as many as 13 have been taken from a single stomach. About 30 per cent of the orchard orioles examined in summer contained boll weevils; the total number of weevils eaten by 30 birds was 64, an average of more than 2 to each bird.

Baltimore oriole (see frontispiece).—These brilliant orioles nest sparingly in northern Louisiana and extreme northern and eastern Texas, but over the greater part of these States they occur as migrants only, most commonly in the fall. They reach the cotton-growing districts at about the time that the weevils are making their annual flight, and join with the other orioles in reducing the numbers of the insects. Fifty specimens have been examined, of which 11 had eaten a total of 24 weevils, an average of more than 2 to a bird, or about 50 per cent of the number of birds examined. The largest number of weevils eaten by a single bird was 9.

Bullock oriole.—This is a western species, occurring as far east in Texas as Corpus Christi, Beeville, and Austin. These orioles are rather abundant in the regions they inhabit, and in August and September visit the cotton fields in flocks of 10 to 20 individuals. About 27 per cent of those examined contained boll weevils, the largest number of weevils found in one stomach being 41. The total number of weevils eaten by 40 birds was 133, an average of over 3 weevils to each bird.

BLACKBIRDS.

Blackbirds belong in the same family with the orioles and their services as boll weevil destroyers are even more important.

Seven species occur in Texas in winter, and five of them are known to eat the boll weevil. Their work is done principally in winter and

spring, at a time when it is of the highest importance. Recent investigations have shown that the greatest number of weevils are destroyed by them at the season when the cotton stalks are being raked and the ground first broken.

Brewer blackbird.—The nesting home of these blackbirds is chiefly north of Texas, but in winter vast flocks spread over the State, remaining from October to April. At that season these shiny black fellows, conspicuous by reason of their white eyes, may often be seen walking about the streets of the towns or following the plowman as he turns the furrows. About 15 per cent of the birds examined had eaten boll weevils, the average number of weevils destroyed being nearly 2 to a bird. Most of these individuals were taken in late Feb-

FIG. 6.—Crow blackbird or bronzed grackle.

ruary and March, after the spring plowing had been nearly completed. It is probable that observations made earlier in the winter would show a much larger percentage of weevils destroyed.

Bronzed grackle.—Bronzed grackles or crow blackbirds breed locally in Texas, and great numbers of them pass through the State in spring and fall. They appear in large flocks in February and March, and join the other blackbirds in the fields which are being plowed or cultivated. Of the 34 specimens collected in March, 5 had each eaten a boll weevil.

Great-tailed grackle; "jackdaw."—These large blackbirds are abundant in southern Texas, wintering near the coast and moving northward in summer to about the latitude of Austin. Like other

blackbirds, their destruction of boll weevils is mainly in spring, when the fields are being broken; but naturally, owing to their large size, their taste is usually for larger insects. Thirty-nine specimens collected in spring have been examined, of which only 3 had eaten boll weevils, each bird taking 1 weevil.

Red-winged blackbird.—Redwings occur in Texas at all seasons, but are much more abundant in winter than in summer. They gather in immense flocks as early in the fall as October, and forage in the fields all winter, or until the nesting season approaches in April, when the flocks disperse and the birds pair off. Their food consists very largely of weed seed, but a few insects are consumed, including some boll weevils. About 50 stomachs taken in spring and an equal number taken in autumn have been examined, and in each case 2 stomachs contained 1 weevil each. In view of the great abundance of these birds, the value of their services, particularly in spring, is not inconsiderable.

Cowbird.—Cowbirds are found in Texas in flocks during the greater part of the year, but are most abundant in winter. They associate with the redwings and Brewer blackbirds during certain seasons, and in spring often visit plowed fields to obtain weed seed. Here occasionally they pick up boll weevils. Four stomachs taken in February and March contained each 1 boll weevil, and 3 taken in July and August likewise contained each 1 weevil. Although only about 4.5 per cent of the birds collected in spring contained boll weevils, still their great abundance in the fields makes them a valuable ally of the farmer.

MEADOW LARKS.

Meadow larks are generally distributed in Texas in winter, but in summer they retire to the prairies to breed. Although feeding to some extent in plowed fields, they do not follow the plow as the blackbirds do, but seek their food among the old stalks and rubbish. Here they find and destroy many boll weevils, especially in winter at the time the ground is first broken. Eighty-seven specimens taken in February and March have been examined, and of this number 11 had eaten a total of 15 boll weevils. The percentage of larks taking weevils was much greater for the period from February 26 to March 9 than for any later period. This is explained by the fact that most of the larks collected at that time were feeding in unplowed fields, where the weevils had not been driven out. Of the 29 larks taken during that period, 10, or about 34 per cent, had eaten weevils.

Two hundred and forty-nine specimens taken in the fall have been examined, and of these 40, or about 16 per cent, had captured boll weevils, the total number of weevils eaten being 50.

SPARROWS, GROSBEAKS, ETC.

The members of this family are nearly all seed eaters, and although 10 species have been found to capture boll weevils, none of them, except the painted bunting, seem to feed regularly on the insect. Many of the smaller sparrows, however, are very abundant, so that the good they do in the aggregate is very considerable.

Painted bunting.—These brilliantly colored little sparrows are common over most of Texas in the summer months. During their southward migration in August they are particularly abundant, and at that season hundreds visit the cotton fields every day and seek their food on the plants. They seem to be the only sparrows that show a decided preference for boll weevils. Eighteen birds, or about 16.5 per cent of the number examined, had eaten a total of 19 weevils.

Cardinal; "redbird."—Cardinals are present in the South throughout the year, and in most localities are very numerous. They live chiefly in thickets about the borders of fields or in brushy timber, whence they occasionally fly into the cotton fields. Specimens taken at all seasons excepting midwinter have been examined, but only 3 have been found with boll weevils in the stomach. These were killed in September and contained a total of 4 weevils.

Pyrrhuloxia; "gray grosbeak."—This handsome grosbeak is an inhabitant of the arid mesquite belt of southwest Texas. It is common at Beeville and Runge, where 64 specimens were collected. Of these 2 had each taken a boll weevil.

Dickcissel; black-throated bunting.—These sparrows, which in general appearance resemble the English sparrow, are summer residents in Texas, and during migration are quite abundant in cotton fields. Twenty-six specimens have been examined, of which 3 had taken 1 boll weevil apiece.

Lark sparrow.—Lark sparrows are common in Texas, both in summer and in winter, and during the fall migration are particularly abundant. At that season they swarm in the cotton fields and along roadsides. About 50 specimens were collected, but only 1 had eaten a boll weevil.

Western savanna sparrow.—These are the little "grass sparrows" that are so common during the winter in the fields and meadows. Thirty-nine specimens taken in February and March were examined, and of these 3 had each eaten a boll weevil; of 18 birds taken in November and December 1 had eaten a boll weevil. In view of the great abundance of these sparrows the number of weevils destroyed by them in the course of the winter must be considerable.

White-throated sparrow.—This sparrow is a winter visitant from the North, remaining in Texas from November to April. The white-throats spend their time in thickets and brush piles, scratching among

the dead leaves and rubbish. Of 9 specimens taken in the fall, 1 had eaten a boll weevil. None of the 13 specimens taken in spring had eaten any.

Field sparrow.—Field sparrows occur in Texas both in winter and in summer, more commonly, however, in the winter. They are lovers of brushy pastures and weedy borders of fields. Of 7 specimens taken in February and March, 1 had eaten a boll weevil.

Towhee; chewink.—These rather large sparrows pass the winter in Texas, feeding in thickets and brushy pastures. Of the 6 specimens collected in spring, 1 had eaten a boll weevil.

UPLAND PLOVER.

These fine birds, known as "plover" or "papabotte" in the South, in recent years have been very much reduced in numbers. Breeding in the North from Kansas to Canada, and wintering in South America, they pass through Texas in spring and fall, when great numbers are shot for food. They are essentially prairie dwellers and only occasionally come into the bottomland fields; but wherever the prairies are cultivated they visit the plowed fields in considerable numbers and pick up a great many insects. In fact their food consists almost exclusively of insects and, besides the boll weevil, includes great numbers of other weevils. Of the plover thus far examined, only 13 have been taken in cotton fields. One of these, collected April 9 at Columbus, Tex., contained a boll weevil. Forty-eight specimens taken on the prairies in March were examined, but while their stomachs were filled with weevils of several species and other insects, no boll weevils were found. The fact that the plover are so fond of weevils strongly suggests that if their numbers can be increased by protection, so that more of them will visit cotton fields, they will render valuable aid in destroying the boll weevil. Their spring migration brings them to south Texas about March 15, and from that date until May 1 or later they are moving gradually northward across the State. They are thus present at the most critical period in the development of the boll weevil, and every weevil destroyed at this time means a great deal to the cotton grower. Their autumn migration brings them into the cotton districts in August, when they are said to visit the cotton fields in numbers. Further investigations are necessary to show the nature of their food at this season.

KILLDEER.

Killdeers breed throughout Texas and Louisiana and winter abundantly in the southern portion of these States. Although mainly a bird of the pasture, they frequently visit plowed fields, and in spring gather in flocks to feed in the freshly-turned furrows. Twenty-one

specimens taken in February and March have been examined, and of these 1 had eaten 2 boll weevils, another 3. In the summer and fall they rarely feed in the fields.

QUAIL.

Quail stomachs to the number of nearly 200, taken in every month excepting January, May, and June, have been examined, and thus far only 1 boll weevil has been found. Quails are very largely seed eaters, insects forming only about 15 per cent of their food for the entire year.[a] Under favorable conditions they are likely to pick up some boll weevils, but in view of the results of stomach examinations already made, they can not be expected to destroy large numbers of weevils, and statements of quails' crops found "filled with weevils," which appear from time to time in the newspapers, must be taken with many grains of allowance.

NIGHTHAWK; "BULL BAT."

Nighthawks breed locally throughout Texas and Louisiana, particularly in plains and prairie regions, but usually are not abundant in farming districts, except during migrations. Only 10 specimens, taken in August and September, have been examined, and of these 4 contained a total of 15 boll weevils. Two of these birds had each eaten 6 weevils. Nighthawks are thus seen to be important enemies of the boll weevil, and wherever they occur they should be carefully protected.

WARBLERS.

The warbler family is represented in Texas by a large number of species, most of which are inhabitants of woodland. A few species have been observed in cotton fields, and two of them have been found to eat boll weevils.

Yellow warbler.—Yellow warblers are common in Texas in summer, and during August and September they frequent the cotton fields in some numbers. Twenty-five specimens have been examined, 1 of which had eaten a boll weevil.

Yellow-breasted chat.—Chats occur sparingly in the timbered portions of Texas. They are lovers of thickets and usually are so shy that they are not often seen. Five specimens were taken in September in a cotton field bordered by thickets, and 1 was found to have eaten a boll weevil.

TITMICE AND WRENS.

Two species of titmice and the Carolina wren have been found to destroy boll weevils. They are forest-loving birds and their work is done chiefly during the winter, when the weevils are in hiding.

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[a] Judd, Bul. 21, Biological Survey, U. S. Dept. of Agriculture, 1905, p. 37.

Tufted titmouse and black-crested titmouse.—One or the other of these closely related species is found over most of the timbered portions of Texas, the tufted titmouse being the more eastern and the black crested the more western in distribution. The former only is found in Louisiana. One tufted tit taken in March and 1 black-crested tit taken in December had each eaten 1 boll weevil. More specimens taken in winter would probably furnish additional evidence of their value as weevil destroyers. The absence of boll weevils from 23 stomachs taken in April and May merely indicates that by this time the weevils had left their winter quarters in the timber and therefore were inaccessible to the titmice.

Carolina wren.—These sprightly little wrens live in the timbered sections of Texas and Louisiana throughout the year. They frequent dense thickets and are especially fond of clearings choked with fallen timber. In such situations they seek and capture boll weevils during the period of hibernation. Of specimens taken in the fall (November and December), 5 had eaten a total of 6 boll weevils. Their record in spring is not so good, for of 14 specimens examined in March and early April only 1 contained weevils. This one was shot in a tree heavily covered with Spanish "moss" in which the bird had a nest. The 2 weevils which he had eaten were doubtless taken from the moss, where they are known to hibernate.

MOCKINGBIRD.

Mockingbirds, taken in every period of the year excepting mid-winter, have been examined, but very few boll weevils have been found in their stomachs. Two birds shot on February 24 each contained 1 boll weevil,[a] but 35 others taken in February, March, and April showed no boll weevils in the stomach contents. In summer, 85 specimens have been examined, only 5 of which contained boll weevils, each of these containing 1 weevil.

WHITE-RUMPED SHRIKE.

Shrikes, known in the South under the names "loggerhead" and "French mockingbird," are generally distributed over the cotton country, being more common in winter than in summer.

Fifty-four specimens, taken at all seasons, have been examined, only 2 of which contained boll weevils. These 2 were taken in December, 1 of them having eaten 4 weevils, the other 1.

AMERICAN PIPIT.

Pipits, or titlarks, as they are sometimes called, breed in the North and winter abundantly in Texas. At that season large flocks visit the

[a] Bul. 51, Bureau of Entomology, U. S. Dept. of Agriculture, 1905, p. 153.

cotton fields and run about among the old stalks in search of food. Thirteen specimens have been examined, of which 3, taken in November, had eaten a total of 4 boll weevils.

BROWN THRASHER.

Brown thrashers are common winter residents in Texas and Louisiana, inhabiting thickets and brushy timber. Only 1 of the 38 specimens examined had eaten a boll weevil.

INVESTIGATIONS IN THE SUMMER OF 1906.

FIELD CONDITIONS.

At the time field investigations were being conducted in 1906 (August and September) boll weevils had reached about their maximum numbers. In nearly every locality visited they were more abundant than at a corresponding date in 1905. The damage to the crop in many sections was very serious; in others the infestation came too late to injure much more than the "top crop."

During September the weevils made their annual migration, and at that time large numbers of them were captured in the air by birds that feed on the wing.

Birds were rather scarce in east Texas and Louisiana, but abundant in south Texas. Of the 314 specimens collected about one-fourth had captured boll weevils. At one locality (Victoria) 42 per cent of the birds examined had eaten boll weevils.

SUMMARY OF OBSERVATIONS.

Logansport, La., August 25–27.—Weevils were abundant here and had damaged the crop very considerably. Late planted cotton especially had been able to mature very few bolls. The fields here are not extensive, so that the weevils were concentrated on the comparatively small area of cotton bearing buds and bolls. Thirty plants were examined and 78 weevils found. Five larvæ were found in one boll.

Birds were scarce here, excepting woodpeckers. Nineteen specimens were taken, most of them in the brush bordering a cotton field close to the river. Only 2 birds had eaten boll weevils—a crested flycatcher, which had eaten 3, and a mockingbird, which had eaten 1.

Columbus, Tex., September 4–6.—Cotton was in fine condition here and a fair crop of bolls had already matured. Squares were still abundant on the plants, but over 50 per cent of them were punctured. Weevils were numerous, 48 having been found on 40 plants. Grasshoppers also were abundant and furnished food for many birds. Cotton worms were present in small numbers. Birds were not common about the cotton fields, though a good many were

seen in the timber and around the dooryards in town. Cliff swallows and bank swallows were quite numerous, and about 30 rough-winged swallows were seen. Twenty-two birds were collected, but only 3 had taken boll weevils. One cliff swallow had eaten 6, another 20 boll weevils, these being the only birds of the species taken. Two bank swallows were collected, 1 of which had eaten 2 boll weevils.

Victoria, Tex., September 10–15, 1906.—The cotton fields in the river bottom here are extensive. Cotton worms were abundant and quite generally distributed; some of the fields had been entirely stripped of leaves and buds by them, while other fields were in process of denudation. Boll weevils also were abundant, but on account of the ravages of the cotton worms were concentrated on the green cotton, and doubtless large numbers were flying about from field to field in search of food. September 10, 25 plants were examined and 40 weevils found on them; September 14, 15 plants were examined and 89 weevils found—an average on both days of about 3 to the plant. This count was made, of course, in fields where there were still a good many squares.

Birds were abundant here, and 150 specimens of 22 species were collected; 63 individuals of 12 species were found to have eaten boll weevils. Four of the 7 species of flycatchers present here had eaten weevils—the kingbird, olive-sided flycatcher, least flycatcher, and alder flycatcher. The kingbird was quite numerous, and of the 12 specimens taken 6 had eaten a total of 8 weevils. Two olive-sided flycatchers were taken, one of which had eaten 2 boll weevils. The smaller flycatchers were quite numerous, and 3 species were taken; of the 2 alder flycatchers taken 1 had eaten 2 weevils, and of the 4 least flycatchers 2 had eaten 5 weevils apiece. Both the orchard oriole and the Baltimore oriole were present in some numbers, but they seemed to feed on the weevil less frequently than during last summer (1905). Fourteen orchard orioles were collected, and of these only 3 had eaten weevils—1 taking 2, another 1, and another 13 weevils. Of 13 Baltimore orioles taken, only 1 had eaten the weevil—this one taking 9 weevils. It seems probable that the abundance of cotton worms induced the orioles to neglect the boll weevils.

Swallows were the most abundant birds here during the writer's stay, and all of the 4 species taken proved to be feeding on boll weevils. The cliff swallow was the most abundant species, and several thousand passed over each day in their leisurely southward migration. Frequently 25 to 50 were in sight at once over the cotton fields, and on some days a continuous stream of swallows was passing for several hours at a time. They flew usually at a height of 20 to 30 feet above the ground, occasionally, however, rising to a considerably greater height. Thirty-three specimens were collected, and all but 1 of them had eaten boll weevils. The total number of weevils

destroyed by the 32 birds was 612, an average of 19 to the bird. The largest number taken by one bird was 47.

The bank swallow was almost as common as the cliff swallow, and the habits of the two are quite similar. Twenty-two specimens were taken and 9 of them found to have eaten boll weevils. The largest number eaten by a single bird was 14, the total consumed by the 9 birds was 63, and the average per bird 7.

The barn swallow was less common than the other species of swallows, and their habits differ slightly from those of the others. They were most often seen skimming swiftly over the cotton only a short distance above the tops of the plants. They flew back and forth across the fields many times, and the evidences of a movement southward were not apparent. Eleven specimens were taken, and of these 5 had eaten a total of 52 boll weevils, an average of over 10 per bird. The largest number eaten by a single bird was 23.

Several purple martins were seen, but only one secured. This one contained fragments of a boll weevil.

Two species of warblers taken here—the chat and the yellow warbler—were each found to have eaten boll weevils. Five specimens of each were taken, and 1 bird of each species had eaten 1 weevil apiece.

Beeville, Tex., September 17–19.—Weevils were quite scarce at Beeville this season, and the damage to the cotton by them was comparatively slight. At the time of the writer's visit there were few squares on the plants, and consequently many plants harbored no weevils. By selecting and examining 30 plants on which there was a moderate number of squares 23 weevils were found. Cotton worms were present in small isolated colonies.

Birds were much less numerous than in August of the preceding year. Twenty-two specimens were taken, including 11 orioles. Six of the orioles had eaten boll weevils. The single orchard oriole taken had eaten 1 weevil, the single Bullock oriole taken had eaten 2 weevils, and of the 9 Baltimore orioles taken 4 had eaten a total of 5 weevils.

Runge, Tex., September 20–25.—Cotton was still growing and putting on squares at the time of my visit. Weevils were abundant, almost every plant harboring some of the insects, except in fields where the leaf worm had defoliated the plants. Twenty-five plants were examined and 52 weevils found. Cotton worms were only moderately common and locally distributed.

Birds were fairly abundant, but the species known to eat the most weevils were scarce. Thirty-nine specimens were taken, but only 3 birds had eaten boll weevils. Five nighthawks were secured, 2 of which had eaten boll weevils—1 taking 2, the other 6. Fourteen

scissor-tailed flycatchers were taken, only 1 of which had eaten a boll weevil.

Kerrville, Tex., September 28–29.—Several fields of cotton at Lacey's ranch, on Turtle Creek, were examined, and weevils were found to be quite common. Twenty-seven individuals were found on 10 plants.

Cardinals were numerous, and 4 were shot in a cotton field. One of these had eaten 2 boll weevils. Two phœbes also were taken here, 1 of which had eaten a boll weevil.

INVESTIGATIONS IN THE WINTER AND SPRING OF 1907.

FIELD CONDITIONS.

The winter of 1906–7 in Texas and Louisiana was unusually mild and generally quite dry. Over most of the cotton-growing area of these States frosts were few and light, and seppa cotton was found commonly, in April, even as far north as Waco, Tex., and Mansfield, La. Such conditions were extremely favorable to the hibernating boll weevils, and in portions of south Texas they were more or less active throughout the winter. Large numbers emerged from hibernation in March, and during that month many were found feeding on seppa cotton. Judging from the small number of weevils found in birds' stomachs taken in April, it seems probable that by that time the majority had emerged from hibernation and begun to feed on the young cotton plants.

Observations were carried on chiefly at five localities in south and central Texas and northwestern Louisiana. A comparison of the relative number of weevils found in the birds examined at different periods shows clearly that the best work of birds is accomplished early in the season, while the weevils are still in their hibernating quarters. Thus in the period from February 11 to 16 in south Texas, with seppa cotton abundant, 6.6 per cent of the birds examined contained boll weevils; from February 26 to March 9 in central Texas, with the seppa cotton scarce, 13 per cent contained boll weevils; from March 12 to April 11 in south Texas (same localities as in February) 2.7 per cent contained boll weevils; from April 12 to 24 in central Texas (same localities as in March) none contained boll weevils, and from April 26 to May 23, in northwestern Louisiana, 2.3 per cent contained boll weevils.

SUMMARY OF OBSERVATIONS.

Cuero, Tex., February 11–12.—Nearly all fields were plowed and cotton was being planted. Birds were abundant, particularly vesper

sparrows and savanna sparrows. A few small flocks of Brewer blackbirds were feeding in the plowed fields. Eleven of these blackbirds were collected and 4 were found to have eaten boll weevils, one taking 4 weevils, the others 1 each. Seven of the savanna sparrows were taken and in 1 a boll weevil was found.

Victoria, Tex., February 13–16.—Most of the fields in this vicinity had been plowed and some had been planted. Dry weather had retarded the farming operations on many of the farms. Brewer blackbirds were quite abundant and 22 specimens were taken, most of them in a large field in process of being plowed, in which the stalks had been broken down a month or more ago. There was considerable rubbish, consisting of dead grass and old cotton bolls and stalks, on the ground in this field, but a careful examination of a half bushel of this rubbish failed to show any weevils. Three of the Brewer blackbirds taken in the field, however, had each eaten a boll weevil, and 2 taken in another field had each captured 3 boll weevils. Sixteen killdeer were taken in the field above referred to, but none of them had eaten weevils. They fed mainly on large, juicy larvæ turned up by the plow. A single killdeer shot while flying over a pasture near town had remains of 2 boll weevils in its stomach. Savanna sparrows were abundant here, as at Cuero, and of the 7 birds taken, 1 contained a boll weevil.

Gurley, Tex., February 26 to March 9.—At this date only about half of the Gurley ranch had been plowed and no cotton had as yet been planted. Birds were only moderately abundant, the most numerous species being meadow larks, savanna sparrows, and vesper sparrows. One hundred and forty-six specimens of 29 species were collected here, and 19 individuals, or 13 per cent of the total number taken, were found to have eaten boll weevils. The weevils at this date were probably found in their hibernating quarters or else crawling about in search of cotton plants on which to feed. Large flocks of blackbirds of several species flew nightly down the valley to roost, but very few of them alighted in the fields to feed. A flock of bronzed grackles lived for several days about the fields, following the plow in the furrow or the harrow as the old stalks were being raked. Eighteen specimens of this blackbird were taken, 5 of which had each eaten a boll weevil. These 5 birds were all taken in one day in a small field where the old cotton stalks were being raked.

Eleven eastern meadow larks and 18 western meadow larks were taken in the fields, and of this number 3 of the eastern larks and 7 of the western larks had eaten boll weevils, the total number of weevils taken by the 10 birds being 14. They were not in the habit of following the plow, as the blackbirds do, but fed in the open portions of the unplowed fields or among the standing stalks of cotton left from last

season. The weevils eaten by them were doubtless picked up from the rubbish scattered about the fields.

Only 4 of the savanna sparrows were examined, and of these 1 contained a boll weevil. These sparrows were very numerous about the fields and the number of weevils destroyed by them at this season must be very large. Two other members of the sparrow family were found to have eaten boll weevils—the little field sparrow and the larger chewink or towhee bunting. Both of these species frequent the dense thickets and the field sparrow is found also about the brushy borders of the cotton fields. Five of the towhees and 4 of the field sparrows were collected, and one of each had eaten a boll weevil.

The tufted titmouse occurs sparingly in this portion of Texas, living in the timbered bottoms and in the post oaks. The single bird collected at Gurley contained a boll weevil, which had probably been secured in the upland timber.

Cuero, Tex., March 12–22.—At this date most of the cotton had been planted and much of it was up from 1 to 2 inches. On account of the unusual mildness of the past winter, a great many plants of seppa cotton were growing in the fields, and upon these plants most of the weevils were feeding. On March 18, 100 plants of seppa were examined for boll weevils and 14 of the insects found.

Blackbirds of three species—Brewer blackbirds, redwings, and cowbirds—were abundant in the fields, where they settled in large flocks, numbering a thousand or more, to feed on insects turned up by the plows. Meadow larks and savanna sparrows also were quite numerous, but other birds were rather scarce. About 200 specimens were taken, but only 6 individuals had eaten boll weevils. Of the 48 Brewer blackbirds collected, 3 had eaten 1 weevil apiece, and of the 60 cowbirds taken, 3 had likewise eaten 1 weevil each. These results indicate clearly that the birds do not find the weevils to any extent after they have begun to feed on the young cotton, and demonstrate the necessity for destroying every stalk of seppa cotton in order that the weevils which emerge early from hibernation may be deprived of food and at the same time exposed to the attacks of the birds.

Victoria, Tex., March 25 to April 4.—Conditions here were much the same as at Cuero. Cotton was 1 or 2 inches high and receiving the first cultivation before being thinned. Boll weevils were numerous, and said to have been more or less active all winter. Twenty stalks of seppa examined on April 1 showed 12 feeding weevils. Two hundred and twenty-nine birds were collected, but only 5 individuals had eaten boll weevils.

Blackbirds were still abundant, though less so than in February. Five species were represented, the most numerous being the redwings, the bronzed grackles, and the great-tailed grackle or jackdaw.

The redwings fed mainly in pastures grown up to huisache, but they were occasionally seen in cultivated fields. Of the 18 specimens collected, 2 were found to contain 1 boll weevil each. The great-tailed grackles were very fond of following the plow, but only 1 of the 17 birds taken had picked up a boll weevil. The meadow larks were much reduced in numbers, most of them having retired to the prairies to breed. Eight specimens were taken in the fields and the stomach of one of them contained a boll weevil.

Columbus, Tex., April 6–11.—Cotton was a little farther advanced here than at Victoria, and there was a large quantity of seppa growing in most of the fields. Six boll weevils were found on 25 stalks of the seppa. Birds were rather scarce about the fields. About 50 specimens were collected, only 2 of which had eaten boll weevils.

Four Carolina wrens were taken in the timber along the river, and the stomach of 1 of them contained 2 boll weevils. A flock of about 15 upland plover was found feeding in a cultivated field, where they followed the plowman or ran about among the young cotton and corn in search of insects. They were very wild, but 6 specimens were secured, 1 of which had eaten a boll weevil.

Gurley, Tex., April 12–24.—At this date cotton was 3 or 4 inches high, but not yet thinned. Only a few stalks of seppa had survived the frosts, but these had been discovered by the weevils, which were thus provided with food until the planted cotton became available. Three weevils were found on 1 seppa plant and 1 on another.

Birds were rather scarce at this date. About 100 specimens were taken, mainly the smaller brush-inhabiting species, but none of them had eaten boll weevils.

Mansfield, La., April 26 to May 3.—On account of a cold, wet spring the cotton here was very backward, and most of it had been planted over once or even twice. Seppa cotton had survived the late frosts, however, and boll weevils were found feeding on these plants.

Birds were very abundant, particularly woodpeckers, wrens, titmice, wood pewees, and orchard orioles. Most of them, however, fed in the timber where insect food was abundant. Kingbirds were numerous about the fields and pastures, and of 8 specimens collected 1 had captured a boll weevil.

Crested flycatchers were not common and, as they frequent the taller trees in the woods, it was somewhat of a surprise to find 2 boll weevils in the stomach of a specimen, shot from the top of a large pine, at some distance from the cotton fields.

The orchard orioles, whose usefulness during the summer months as boll weevil destroyers has been well established, were found to be already beginning their good work. Eighteen specimens were examined and 1 of them (taken April 27) had eaten a boll weevil.

SCHEDULES OF STOMACH EXAMINATIONS.

RECORD OF BIRDS EXAMINED WHICH HAD EATEN BOLL WEEVILS.

Species.	During January, February, and March.			During April, May, and June.			During July, August, and September.			During October, November, and December.		
	No. of birds examined.	No. eating boll weevils.	No. of boll weevils eaten.	No. of birds examined.	No. eating boll weevils.	No. of boll weevils eaten.	No. of birds examined.	No. eating boll weevils.	No. of boll weevils eaten.	No. of birds examined.	No. eating boll weevils.	No. of boll weevils eaten.
Upland plover (*Bartramia longicauda*)	48	....	....	13	1	1	1	....	....	....	....	....
Killdeer (*Oxyechus vociferus*)	21	2	5	1	....	....	6	....	....	1	....	....
Texan quail (*Colinus virginianus texanus*)	40	....	....	10	....	....	38	....	....	108	1	1
Western nighthawk (*Chordeiles v. henryi*)	....	....	....	....	....	....	10	4	15	....	....	....
Scissor-tailed flycatcher (*Muscivora forficata*)	....	....	....	....	....	....	91	5	7	....	....	....
Kingbird (*Tyrannus tyrannus*)	....	....	....	10	1	1	22	6	8	....	....	....
Crested flycatcher (*Myiarchus crinitus*)	....	....	....	7	1	2	5	1	3	....	....	....
Phœbe (*Sayornis phœbe*)	8	....	....	....	....	....	2	1	1	13	3	3
Olive-sided flycatcher (*Nuttallornis borealis*)	....	....	....	....	....	....	2	1	2	....	....	....
Alder flycatcher (*Empidonax trailli alnorum*)	....	....	....	....	....	....	3	1	2	....	....	....
Least flycatcher (*Empidonax minimus*)	....	....	....	....	....	....	14	7	21	....	....	....
Cowbird (*Molothrus ater*)	88	4	4	....	....	....	84	3	3	24	....	....
Red-winged blackbird (*Agelaius phœniceus*)	34	1	1	16	1	1	11	....	....	49	2	2
Meadow lark (*Sturnella magna* and subspecies)	37	4	6	1	....	....	1	....	....	183	28	32
Western meadow lark (*Sturnella neglecta*)	50	7	9	....	....	....	....	....	....	66	12	18
Orchard oriole (*Icterus spurius*)	....	....	....	20	1	1	101	30	64	....	....	....
Baltimore oriole (*Icterus galbula*)	....	....	....	2	....	....	50	11	24	....	....	....
Bullock oriole (*Icterus bullocki*)	....	....	....	....	....	....	149	40	133	....	....	....
Brewer blackbird (*Euphagus cyanocephalus*)	101	15	28	1	....	....	....	....	....	5	2	2
Bronzed grackle (*Quiscalus q. æneus*)	36	5	5	19	....	....	3	....	....	3	....	....
Great-tailed grackle (*Megaquiscalus major macrourus*)	32	2	2	7	1	1	6	....	....	2	....	....
Western savanna sparrow (*Passerculus s. alaudinus*)	39	3	3	2	....	....	....	....	....	18	1	1
Western lark sparrow (*Chondestes grammacus strigatus*)	....	....	....	13	....	....	54	1	1	....	....	....
White-throated sparrow (*Zonotrichia albicollis*)	9	....	....	4	....	....	....	....	....	9	1	1
Field sparrow (*Spizella pusilla*)	7	1	1	....	....	....	5	....	....	....	....	....
Towhee (*Pipilo erythrophthalmus*)	5	1	1	....	....	....	....	....	....	6	....	....
Cardinal (*Cardinalis cardinalis*)	21	....	....	7	....	....	39	3	4	....	....	....
Texan pyrrhuloxia (*Pyrrhuloxia sinuata texana*)	....	....	....	....	....	....	64	2	2	....	....	....
Painted bunting (*Passerina ciris*)	....	....	....	....	....	....	109	18	19	....	....	....
Dickcissel (*Spiza americana*)	....	....	....	1	....	....	26	3	3	....	....	....
Purple martin (*Progne subis*)	....	....	....	15	1	1	5	1	1	....	....	....
Cliff swallow (*Petrochelidon lunifrons*)	1	....	....	1	....	....	35	34	658	....	....	....
Barn swallow (*Hirundo erythrogastra*)	....	....	....	....	....	....	14	5	52	16	....	....
Bank swallow (*Riparia riparia*)	....	....	....	....	....	....	25	11	68	....	....	....
White-rumped shrike (*Lanius l. excubitorides*)	19	....	....	4	....	....	19	....	....	12	2	5
Yellow warbler (*Dendroica æstiva*)	....	....	....	....	....	....	25	1	1	....	....	....
Yellow-breasted chat (*Icteria virens*)	....	....	....	....	....	....	5	1	1	....	....	....
American pipit (*Anthus pensilvanicus*)	5	....	....	....	....	....	....	....	....	8	3	4
Mockingbird (*Mimus polyglottos*)	24	2	2	13	....	....	85	5	5	5	....	....
Brown thrasher (*Toxostoma rufum*)	2	....	....	7	....	....	....	....	....	29	1	1
Carolina wren (*Thryothorus ludovicianus*)	7	....	....	31	1	2	1	....	....	7	5	6
Tufted titmouse (*Bæolophus bicolor*)	1	1	1	23	....	....	....	....	....	....	....	....
Black-crested titmouse (*Bæolophus atricristatus*)	....	....	....	....	....	....	1	....	....	2	1	1

RECORD OF BIRDS EXAMINED WHICH HAD NOT EATEN BOLL WEEVILS.

Species.	Number of birds examined during—			
	January, February, and March.	April, May, and June.	July, August, and September.	October, November, and December.
Mourning dove (*Zenaidura macroura*)	2	.....	115	112
Mexican ground dove (*Chæmepelia passerina pallescens*)	.....	.....	.....	5
Yellow-billed cuckoo (*Coccyzus americanus*)	.....	1	48	.....
Downy woodpecker (*Dryobates pubescens*)	.....	4	.....	.....
Red-cockaded woodpecker (*Dryobates borealis*)	.....	2	.....	.....
Texan woodpecker (*Dryobates scalaris bairdi*)	.....	.....	4	2
Red-headed woodpecker (*Melanerpes erythrocephalus*)	.....	14	4	3
Red-bellied woodpecker (*Centurus carolinus*)	.....	.....	2	2
Golden-fronted woodpecker (*Centurus aurifrons*)	.....	.....	4	.....
Flicker (*Colaptes auratus*)	2	1	1	3
Wood pewee (*Contopus virens*)	.....	18	4	.....
Yellow-bellied flycatcher (*Empidonax flaviventris*)	.....	.....	6	.....
Green-crested flycatcher (*Empidonax virescens*)	.....	1	1	.....
Blue jay (*Cyanocitta cristata*)	.....	1	1	2
Rusty blackbird (*Euphagus carolinus*)	.....	.....	.....	10
Western vesper sparrow (*Poœcetes gramineus confinis*)	21	.....	.....	11
Western grasshopper sparrow (*Ammodramus s. bimaculatus*)	12	2	.....	5
White-crowned sparrow (*Zonotrichia leucophrys*)	3	8	.....	4
Western tree sparrow (*Spizella m. ochracea*)	.....	.....	.....	5
Clay-colored sparrow (*Spizella pallida*)	.....	7	.....	.....
Bachman sparrow (*Aimophila a. bachmani*)	.....	3	.....	.....
Lincoln sparrow (*Melospiza lincolni*)	14	8	.....	.....
Fox sparrow (*Passerella iliaca*)	2	.....	.....	9
Blue grosbeak (*Guiraca cærulea*)	.....	.....	3	.....
Indigo bunting (*Passerina cyanea*)	.....	2	1	.....
Summer tanager (*Piranga rubra*)	.....	7	1	.....
Rough-winged swallow (*Stelgidopteryx serripennis*)	.....	2	7	.....
Cedar waxwing (*Ampelis cedrorum*)	.....	5	.....	.....
Red-eyed vireo (*Vireosylva olivacea*)	.....	5	1	.....
White-eyed vireo (*Vireo noveboracensis*)	1	7	2	.....
Nashville warbler (*Vermivora rubricapilla*)	.....	.....	4	.....
Myrtle warbler (*Dendroica coronata*)	2	3	.....	.....
Pine warbler (*Dendroica vigorsi*)	.....	5	.....	.....
Kentucky warbler (*Oporornis formosa*)	.....	3	.....	.....
Mourning warbler (*Oporornis philadelphia*)	.....	6	.....	.....
Northern yellowthroat (*Geothlypis trichas brachidactyla*)	1	1	1	.....
Curve-billed thrasher (*Toxostoma curvirostre*)	.....	6	1	.....
Texan Bewick wren (*Thryomanes bewicki cryptus*)	2	.....	3	2
Western house wren (*Troglodytes aëdon parkmani*)	4	2	.....	.....
Blue-gray gnatcatcher (*Polioptila cærulea*)	1	11	.....	.....
Brown-headed nuthatch (*Sitta pusilla*)	.....	7	.....	.....
Hermit thrush (*Hylocichla g. pallasi*)	2	1	.....	.....
Bluebird (*Sialia sialis*)	3	22	.....	6